



## Case report

## Intracranial penetrating injury by screw driver: A case report and review of literature



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## ABSTRACT

Penetrating injury to the head, with the exception of missile injuries is rare owing to thick calvarium. Orbital and temporal areas are comparatively vulnerable to penetrating injuries, due to their relative thinness. A case is presented in which a man killed his wife by forcefully thrusting a screw driver into her cranial cavity. The deceased presented to the hospital with the screw driver embedded in her head. She was declared as 'brought dead on arrival' at the emergency of the hospital. Pre-autopsy plain radiography and Computed Tomography (CT) of the head were done to assess the extent of brain damage. The peculiarity of this case lies in the fact that screw driver as a stabbing weapon in the head is very rarely used. In such cases, there is a need to perform radiography and CT with the weapon in-situ for better interpretation on injuries. In this paper role of radiography and CT in intra cranial penetration is discussed with review of literature.

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## 1. Introduction

Skull bones and overlying muscles provide reasonable protection to the delicate brain tissue. Low-velocity penetrating wounds of the brain are uncommon as the skull and its coverings usually provide an effective protective barrier. However, skull can be penetrated through its foramina and in areas where the bones are thin. Orbit and temporal regions constitute areas of thin bone which can be penetrated with relative ease.<sup>1,2,15</sup> Incidence of penetrating injury to the cranial cavity is quite rare in comparison to other body cavities.<sup>2</sup> Various stabbing objects such as long pointed objects or knives have been implicated in penetrating trauma to the skull responsible for homicidal, accidental and suicidal deaths resulting from the penetration of the cranium.<sup>1,2</sup> A review of related cases across the world suggests a small number of cases (around 19) of penetrating injuries to the head. Out of these reported cases, 10 are homicidal, 3 are suicidal and the rest were accidental. In the instant case a screw driver was used into the cranial cavity of the deceased.

## 2. Case report

On the fateful night, a scuffle erupted between the deceased and her husband. In a fit of rage the husband forcefully thrust a screw driver into his wife's head. She was taken to a nearby hospital where she was declared as 'brought dead on arrival'.

Post-mortem examination was conducted on the following day. While the screw driver was still firmly embedded in the head, a part of the metallic body and whole plastic handle screw driver was found to be jutting out. Pre-autopsy plain radiography and computerized tomography of the head was done (Fig. 1 and Fig. 2).

At autopsy, the screw driver was found penetrating the skull and could only be removed with some effort (Fig. 3). A penetrating wound of size 0.7 cm × 0.7 cm × 8.0 cm, circular shape was found present at the right temple. Dissection revealed that it had pierced through the entire thickness of the right temporal bone and entered the cranial cavity; piercing through the underlying dura causing a nearly circular defect 0.3 cm × 0.3 cm in size. It then entered the brain matter causing a laceration in the right frontal lobe, traversing through the anterior part of right basal ganglia, right lateral ventricle and left lateral ventricle. Subdural haemorrhage was present on the right cerebral surface, subarachnoid haemorrhages were present on the right temporo-occipital region, fluid and clotted blood were present in the ventricles. Direction of the wound was downward, backward and inward. Massive extravasation of blood was present along the wound track.

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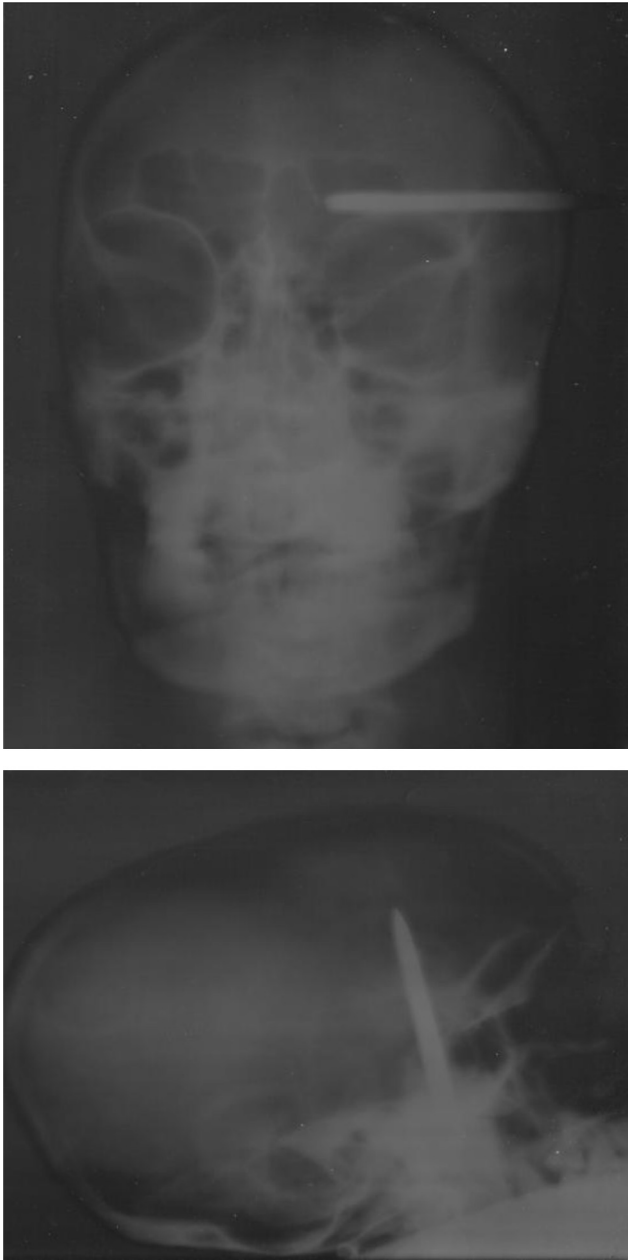


Fig. 1. X-rays images of head with screw driver in cranial cavity.

### 3. Discussion

Tremendous force is required to inflict intracranial stab injury because of thick skull bones. Although average thickness of skull is 6 mm, individual skull bones are of different thickness, occipital bone is thickest at 15 mm, frontal bone is next with 8 mm, parietal bone is 7 mm and temporal bone 4 mm. Orbital plates are papery thin and are liable to fracture easily. Skull is generally thinner where it is protected by thick muscles, and is thicker in the mid-frontal, mid-occipital, parieto-sphenoid and parieto-petrous buttresses.

Forces usually cited to fracture human skull are 1100 lb/in<sup>2</sup> (pound inch square) in the frontal bone, 550 lb/in<sup>2</sup> in the parietal bone, and 225 lb/in<sup>2</sup> at the zygoma.<sup>1,3</sup> To fracture cadaver skull 35 foot-pounds force is required, which can be generated by dropping a stone of weight of 2.25 kg from one feet height.<sup>3</sup>

Some authors evaluated that force required to penetrate the skull is about 5 times higher in the temporal region and 11 times higher in the parietal region<sup>4</sup> than the force needed to perforate the skin.<sup>5</sup> During an actual episode of violence, a further requirement for effective penetration is that the head of the victim must be in a fixed position.<sup>2</sup>

Radiological investigation plays a pivotal role in identification of stabbing weapon in addition to assessment of head injury caused by weapon. For the identification of the weapon, CT should be done immediately, with a view to assess wound dimensions and other characteristics in order to match with the weapon used. Superimpositions of the alleged weapon with the images of CT can prove to be effective for this purpose. In cases where victim survives, CT allows the assessment of the trajectory of weapon in the brain which may be sometimes distorted by secondary bleeding.<sup>2</sup>

In the instant case pre-autopsy CT images showed linear metallic density in the right temporal region, a few bony chips at the entry of the weapon at the cranial vault, multiple contusion at bilateral frontal region, haematoma at left fronto-temporal region. At autopsy, injuries were corresponding and matching with the CT findings. Any further matching of the CT findings and the weapon was not required as the weapon was present in situ in the cranial cavity.

Post mortem diagnosis of intracranial stab injury is easy to establish if a characteristic slot fracture is present. Slot fracture was caused by screw driver at right temporal bone in this case (Fig. 4). The blood-filled wound slit created by a stab wound is largely restricted to the wound tract and corresponds to the dimensions of the penetrating object.<sup>2</sup> Long and pointed objects are invariably used for the intracranial penetration. There is a summary below Table 1, objects involved in intracranial penetration with the manner and site of penetration reported in the literature so far.

Intracranial penetrating injuries by and large are homicidal in nature except a few cases of suicide<sup>1,6,9,16</sup> and accidents.<sup>7,10,11,14</sup> Suicidal intracranial stabbing is mainly attributed to mental unsoundness of the victim; but this is not always true. Multiple stab injuries on other parts of the body, in addition to fatal head injury, are also found in some cases.<sup>6</sup> Knife was exclusively used in all of the suicidal cases with the forehead region being primarily involved followed by the parietal region in the order of incidence.<sup>6,9</sup>

In accidental intracranial penetration the victim usually survives, if the weapon does not involve vital brain stem region. Depths of the injury are less in accidental cases as compared to suicidal and homicidal cases. Screw driver in particular was involved in a couple of cases.<sup>8,10</sup>

Sword fish can also produce fatal intracranial penetrating wound. This incidence has happened in Malaysia.<sup>12</sup> No other case of intracranial penetration by any animal has been reported so far.

Around the world, incidences of intracranial penetration are less commonly targeted regions of the body. In western countries abdomen and chest cavities are preferred sites.<sup>2</sup> Stab injury pattern depends on the fighting situations, for example, in South Africa young adults who indulge in violence with motives like rape and robbery target head.<sup>18</sup> The studies across the world suggest that such cases are found being more commonly reported in the instances of domestic violence, fight among friends, private altercations where the attackers target the vulnerable regions of the victim. Homicidal cases of intracranial stab appear to be male specific kind of violence and no women perpetrators are reported yet. Male can apply adequate force required for intracranial penetration.<sup>2</sup> Almost every kind of pointed object has been used in violent attacks. In the majority of the cases knife<sup>2,7</sup> and screw driver<sup>1,13</sup> were used. In some cases atypical objects like Metal tent stakes and umbrella tip were used.<sup>15,17</sup>

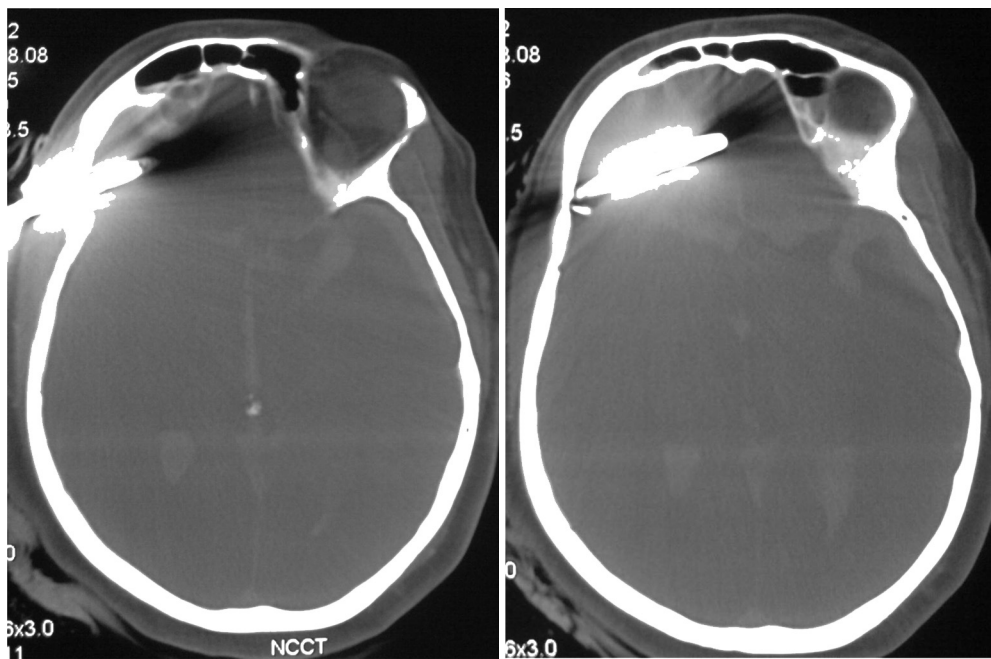


Fig. 2. CT images of head showing screw driver in the cranial cavity.



Fig. 3. Screw driver.

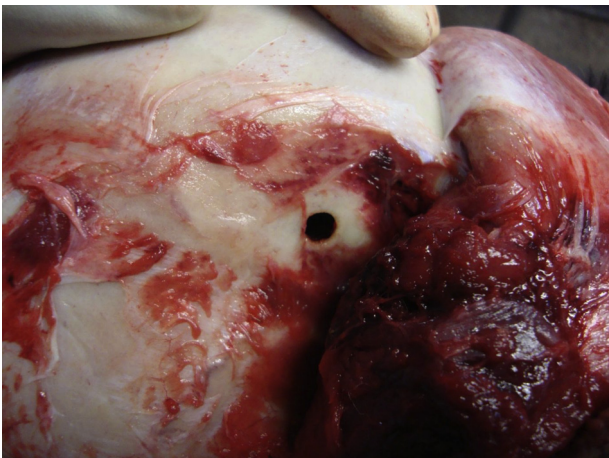


Fig. 4. Slot fracture caused by screw driver.

**Table 1**  
Major cases of intracranial penetration by weapons reported in literature so far.

S no.	First author	Victim	Weapon	Site	Manner
1.	Lawrence C. Dempsey <sup>1</sup>	Male, 43 yrs	Screw driver	Right temporal	Homicidal
2.	Lawrence C. Dempsey <sup>1</sup>	Male, 27 yrs	Knife	Forehead	Suicidal
3.	Lawrence C. Dempsey <sup>1</sup>	Male, 22 yrs	Ice picker	Right meatus	Homicidal
4.	Fekete JF <sup>5</sup>	Male, 53 yrs	Knife	Left parietal	Suicidal
5.	CJ MacEwen <sup>7</sup>	Female, 28 yrs	Bread knife	Intracranial right orbital	Homicidal
6.	Smrkolj V <sup>8</sup>	Male, 28 yrs	Screw driver	Left temporal bone	Homicidal
7.	Smrkolj V <sup>8</sup>	Male, 14 yrs	Screw driver	Right orbital roof	Accidental
8.	M. Bauer, D <sup>2</sup>	Male, 60 yrs	Knife	Right temporal	Homicidal
9.	Iwakura M <sup>9</sup>	Male, 28 yrs	Knife	Parietal	Suicidal
10.	Antonio De Tommasi <sup>10</sup>	Male, 20 yrs	Screw driver	Right maxilla and skull base	Accidental
11.	A. Calvo-Rubal <sup>11</sup>	Male, 46 yrs	Fencing Foil	Intracranial transorbital	Accidental
12.	Gooi BH <sup>12</sup>	Male, 38 yrs	Sword fish	Right orbital wall	Animal attack
13.	Patrícia Bozzeto-Ambrosi <sup>13</sup>	Male, 35 yrs	Screw driver	Left parietal	Homicide
14.	Tudor M <sup>14</sup>	Female, 9 yrs	Sickle's tip	Frontal bone	Accidental
15.	Okí T <sup>15</sup>	Male, 48 yrs	Metal tent stakes	a. Occipital bone b. Right temporal bone	Homicidal
16.	Okí T <sup>15</sup>	Female, 18 yrs	Metal tent stakes	Right temporal bone	Homicidal
17.	Okí T <sup>15</sup>	Female, 78 yrs	Metal tent stakes	Two metal stakes in left temporal bone	Homicidal
18.	Pauline Saint-Martin <sup>16</sup>	Male, 24 yrs	Knife	Frontal bone	Suicidal
19.	Ihama Y <sup>17</sup>	Male, 48 yrs	Umbrella tip	Trans nasal intracranial	Homicidal

Yrs-Years.

#### 4. Conclusion

Although penetrating injuries to the head are relatively rare, the forensic pathologist has to keep in mind its possibility, especially when the weapon is missing or the available history is not all that clear. Pre-autopsy CT evaluation has a definite role in assessment of the extent of injury and in the identification of the weapon of offence.

#### Ethical approval

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#### Conflict of interest

None.

#### References

- Dempsey LC, Winestock DP, Hoff JT. Stab wounds of the brain. *West J Med* Jan 1977;**126**:1–4.
- Bauer M, Patzelt D. Intracranial stab injuries – a case report and case study. *Forensic Sci Int* 2002;**129**(2):122–7.
- Hideo H, Itabashi HH, Andrews JM, Tomiyasu Uwamie, Erlich SS, Sathyavagiswaran L. *Forensic neuropathology: a practical review of the fundamentals*. US: Elsevier; 2007.
- Weber W. Quantitative investigations concerning penetrating wounds of the human skull. *J Leg Med* 1974 May;**74**(2):111–6.
- Callaghan PTO, Jones MD, James DS, Leadbatter S, Holt CA, Nokes LDM. Dynamics of stab wounds: force required for penetration of various cadaveric tissues. *Forensic Sci Int* 1999;**104**:173–8.
- Fekete JF, Fox AD. Successful suicide by self-inflicted multiple stab wounds of the skull, abdomen, and chest. *J Forensic Sci* 1980 Jul;**25**(3):634–7.
- Mac Ewen CJ, Fullarton G. A penetrating orbitocranial stab wound. *Br J Ophthalmol* 1986 February;**70**(2):147–9.
- Smrkolj V, Balazic J, Princic. Intracranial injuries by a screwdriver. *J Forensic Sci Int* 1995 29;**76**(3):211–6.
- Iwakura M, Kawaguchi T, Hosoda K, Shibata Y, Komatsu H, Yanagisawa A, et al. Knife blade penetrating stab wound to the brain-case report. *Neurol Med Chir (Tokyo)* 2005;**45**(3):172–5.
- Tommasi AD, Cascardi P, Tommasi CD, Luzzi S, Ciappetta P. Emergency surgery in a severe penetrating skull base injury by a screwdriver: case report and literature review. *World J Emerg Surg* 2006;**1**:36.
- Calvo-Rubal A, Martinez F, Tarigo. A cranial wounds of the skull caused by a fencing-foil. *Neurocirugia (Astur)* 2006;**17**(6):550–4.
- Gooi BH, Khamizar W, Suhani MN. Swordfish attack–death by penetrating head injury. *Asian J Surg* 2007;**30**(2):158–9.
- Ambrosi PB, Costa LF, Filho AH. Penetrating screwdriver wound to the head. *Arq Neuropsiquiatr* 2008;**66**(1):93–5.
- Tudor M, Tudor L, Tudor KI, Buca A, Cambi-Sapunar L, Carija R, et al. Unusual open craniocerebral injury caused by sickle's tip. *Acta Med Croatica* 2008;**62**(1): 85–8 [Article in Croatian].
- Okii T, Asamura H, Hayashi T, Ota M. Unusual intracranial stab wounds inflicted with metal tent stakes for a case involving a family murder suicide. *Forensic Sci Int* 2010;**202**:1–3.
- Martin PS, Prat S, Bouyssy M, Sarraj S, Byrne OP. An unusual death by transcranial stab wound homicide or suicide? *Am J Forensic Med Pathol* 2008;**29**: 268–70.
- Ihama Y, Nagai T, Ninomiya K, Fukasawa M, Fuke C, Miyazaki T. A transnasal intracranial stab wound by a plastic-covered umbrella tip. *Forensic Sci Int* 2012;**214**:1–3.
- Powell Al. *Bring me my machine gun*. The Hindu; Oct 9, 2012.